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recently rewritten and condensed their standard form of contract and specification.

It is further suggested that at the next convention arrangements be made for papers on this subject by representatives of some contractors' organization and of a bonding company experienced in the contract field.

Feeling that this subject is one on which a systematic campaign of education might well be adopted and that there is very little work to be done until the above suggestions and similar steps have been carried out this committee requests its discharge.

GEORGE W. FULLER,
LEONARD METCALF,
EDWARD E. WALL.

REPORT OF ASSOCIATION'S REPRESENTATIVES ON AMERICAN COMMITTEE ON ELECTROLYSIS

During the war, the American Committee on Electrolysis was not active because its members were too busy with other duties. After printing "A Preliminary Report Prepared for Submission to its Principals by The American Committee on Electrolysis" in 1916, the Committee appointed a Technical Sub-committee to plan a further report on the prevention or mitigation of electrolysis. This sub-committee, having one representative from each organization in the main committee, submitted on February 23, 1917, a carefully prepared outline as follows:

INTRODUCTION.

A. PRINCIPLES, DEFINITIONS AND THEORY.

B. TECHNICAL FEATURES OF CONSTRUCTION AND OPERATION.

I. Features of primary construction which tend to reduce trouble from electrolysis.

1. Railways.

- a. Bonding and cross-bonding.
- b. Improvement of track insulation.
- c. Reinforcement of rail conductivity.
- d. Interconnection of tracks.
- e. Use of additional power supply stations.

2. Affected structures.

- a. Favorable location with respect to tracks.
- b. Pipes laid with insulating joints.
- c. Avoidance of contacts between cables.
- d. Insulation of cable sheaths from earth.
- e. Insulation of pipes from earth.

II. Remedial Measures.

1. Measures Applicable to Railways.
 - a. Insulated track feeder system.
 - b. Three-wire system.
 - c. Reversed polarity of trolley systems
 - d. Double trolley systems.
 - e. A. C. systems.
 - f. Summary.
2. Measures Applicable to Affected Structures.
 - a. Surface insulation.
 - b. Insulating joints.
 - c. Drainage systems for cable and pipe.
 - d. Shielding, or the use of an auxiliary anode.
 - e. Summary.

III. Joint Responsibility of Interests and Necessity for Coöperation.

IV. Conclusions and Recommendations.

1. Primary construction and location.
2. Power supply and distribution.
3. Use and limitation of track feeder system.
4. Use and limitation of drainage system.
5. Other measures.

C. STANDARD METHODS OF MAKING ELECTROLYSIS SURVEYS.

I. Potential Surveys.

1. Overall potential measurements on tracks.
2. Potential gradient measurements in tracks.
3. Potential differences between affected structures, rails, other conductors and earth.
4. Equipment for potential measurements.

II Current Measurements.

1. Current in feeders and rails.
2. Current in pipes, cable sheaths and other affected structures.
3. Measurement methods and equipment needed for 1 and 2.
4. Leakage current from affected structures, methods and equipment.

III. Other Measurements.

1. Bond testing.
2. Resistance between tracks and earth.
3. Earth resistance.
4. Resistance of pipe joints.
5. Determination of source or sources of stray current.
6. Location of concealed connections.

IV. Interpretation of Results of Survey.

D. EUROPEAN PRACTICE.

E. APPENDICES AND DATA.

On February 17, 1919, the Technical Sub-committee met again to revise the work interrupted by the war. On March 31 the main committee met to consider the recommendation of the Technical Sub-committee. Fifteen members were present, each of the eight organizations constituting the main committee being represented. Your two representatives were among them. At this meeting the outline for the second report given above was unanimously adopted.

During the period of enforced inactivity on the part of the Committee, the Bureau of Standards had continued its routine observations and had planned more extensive investigations of electrolysis. To give each organization in the Committee opportunity to share in the direction of these investigations, to get full benefit from them and to contribute services which would make them more complete and authoritative, the Bureau proposed the appointment of a committee of experts to work with its staff. These experts were to be selected and paid by the organizations, each organization having its own, unless it should be found practicable and satisfactory for two or more kindred organizations to unite for the sake of economy. To do the work expected, each expert would necessarily devote much of his time to it. It was roughly estimated that at a fair rate of compensation, with reimbursement for traveling expenses, the cost for each expert would approximate \$3000 for the year.

Records of important actions at the meeting of March 31 are quoted from the official minutes as follows:

As the Technical Subcommittee had recommended that the plan of co-operative work with the Bureau of Standards be adopted, this matter received extended discussion. This brought out the general trend of opinion that such coöperation was very desirable and should be carried out through a small working subcommittee of experts who could devote sufficient time to this subject to advise with the Bureau of Standards on new work to be undertaken, to keep in close touch with the progress of such work, and to participate in drawing conclusions from the results of the work.

Dr. Rosa, speaking for the Bureau of Standards, stated that if competent engineers representing the committee should be appointed, the Bureau would submit to these experts all of its information and data, would discuss with them the conclusions drawn from such data and would submit to the committee in advance of publication, for discussion and criticism, all its reports and technical papers. This plan would enable the Bureau to profit by such expert advice and criticism and would enable the American Committee on Electrolysis to know more of the work of the Bureau as it progressed and to have a part in the planning and execution of such work.

Resolved, that the report of the Technical Subcommittee, of February 23, 1917, be approved and four committees, A, B, C, and D, be appointed to carry out the program of work contained in that report.

These subcommittees are as follows:

- A. Principles, definitions and theories.
- B. Technical features of construction and operation.
- C. Methods of making electrolysis surveys.
- D. European practice.

The following motion was offered by Mr. Flinn and unanimously carried, the motion being intended to provide for the fullest coöperation of the committee with the Bureau and of the Bureau with the committee.

Resolved that the American Committee on Electrolysis appoint a subcommittee of four members with which the Bureau of Standards is requested to collaborate in conducting investigations of electrolysis for the purpose of carrying out the program proposed by the Technical Subcommittee in its report of February 23, 1917, the new subcommittee to be composed of one representative each of the water, gas, lead cable and railway interests, and to coöperate with the Technical Subcommittee, and

Resolved that this new subcommittee may be represented in its work by experts engaged severally by the interests named, subject to the approval of the Chairman of the American Committee on Electrolysis, and

Resolved that this subcommittee report monthly its activities and conclusions, sending copies of such reports simultaneously to the Chairman of the American Committee on Electrolysis and each member thereof, and

Resolved that this subcommittee be authorized to coöperate with the Bureau of Standards in all of its work which can contribute to the attainment of the objects of the American Committee on Electrolysis.

On motion of Mr. Katté it was

Resolved that this subcommittee of four to coöperate with the Bureau of Standards be increased to six in order to include the Electric Light and Power companies and the Steam Railroads separately.

This would provide for two representatives of the pipe interests, two of the lead cable interests and two to represent the railway interests. This resolution was adopted with only one negative vote."

It was agreed that the Committee on Coöperation with the Bureau of Standards consisting of six members would be appointed when nominations are made by the different interests and that any technical experts employed are to serve on this committee of coöperation.

Subsequently, it was agreed that the coöperative committee should have seven members, one each of the members of the main committee from the seven organizations other than the Bureau of Standards. It was also understood that each member of this coöperative committee, unless himself to serve as an expert, should be responsible for the direction of the expert engaged by his organization to work with the Bureau. Mr. Flinn nominates Mr. Edward E.

Minor as the member from the American Water Works Association on this coöperative committee. Prof. Louis A. Hazeltine, professor of Electrical Engineering at Stevens Institute of Technology, Hoboken, New Jersey, is suggested as a suitable expert. He was closely associated with Professor Ganz until the latter's death, and is now consulting engineer to Albert F. Ganz, Inc. He is independent of commercial interests concerned in electrolysis, and competent.

The officers of the American Committee on Electrolysis are: Chairman Bion J. Arnold, consulting engineer, Chicago; Secretary Dr. E. B. Rosa, Chief Physicist, Bureau of Standards, Washington; Treasurer D. W. Roper, Superintendent of Street Department, Commonwealth Edison Co., Chicago, Ill. The Treasurer's financial statement, as of March 1, 1919, showed total receipts amounting to \$2003, total expenditures \$851 and balance \$1152, with which to meet miscellaneous expenses.

At present there is a vacancy in the representation of the American Water Works Association on the American Committee on Electrolysis. It is urged that an appointment be made without further delay, so that the work of the Committee may proceed actively.

Your representatives are impressed with the significance of the existence of the American Committee on Electrolysis, combining all interests, the ability of the men on this Committee, their earnestness, the spirit of fairness and frankness which animates the Committee, and the importance of the work in hand. The American Water Works Association cannot afford to take other than an active part consistent with the magnitude of the interest for which it stands. It is believed that the funds needed to employ an expert to work with the Bureau of Standards can be raised by subscription on suitable appeal.

The undersigned recommend, therefore, authority be granted for the employment of such an expert and that a special committee be appointed to collect the necessary funds. These funds should be paid to the Treasurer and disbursed by him on proper vouchers.

EDWARD E. MINOR.

ALFRED D. FLINN.